15

working paper
department
of economics

SOCIAL MOBILITY AND CORPORATE DEVELOPMENT

Philippe Aghion
Thomas Piketty

Nov.93 93-20

massachusetts
institute of
technology

50 memorial drive
cambridge, mass.02139

SOCIAL MOBILITY AND CORPORATE DEVELOPMENT

Philippe Aghion
Thomas Piketty

Nov.93 93-20

Social Mobility and Corporate Development[1]

Philippe Aghion[2]
Thomas Piketty[3]

November 22, 1993
(First version: May 7, 1993)

[1]We are grateful to seminar participants in Taragonia, Oxford, MIT and LSE for their comments, and to Beatríz Armendariz, Roland Bénabou, Olivier Blanchard, Leonardo Felli, John Goldthorpe, Max Steuer and Jean Tirole for helpful discussions.

[2]Nuffield College, Oxford and EBRD, London.
[3]MIT, Cambridge, MA, USA.

Abstract

Historical evidence suggests that corporations have played a major role in producing information about and in promoting individual talents. This paper analyzes the implications of the corporate promotion mechamism for technological progress and macroeconomic development.

First, given that the fraction of detected talents may depend negatively upon the degree of technological sophistication and that private managers do not appropriate the full social gains of corporate promotions; too skill-intensive new technologies tend to be adopted in equilibrium, the result being a socially excessive rate of technological progress.

Next, in a two-sector economy where an informal, low-productivity sector producing little or no information about talents coexists with the formal corporate sector, information accumulation may exhibit perverse dynamics: low initial information about individual talents may lead the economy to a low-output, low-mobility steady state or "trap," especially when more sophisticated technologies are made available "too soon." Wealth-redistribution policies turn out to be partly ineffective at eliminating this trap; whereas returning for some time to less sophisticated technologies and/or directly subsidizing corporate detection activities can favor the emergence of a broader managerial elite and thereby ensure the transition to the high-output, high-mobility, steady state.

1 Introduction

The view that internal detections play a major role in producing information about talents, and therefore that social mobility and growth may be enhanced by the existence of a "corporate society" (Goldthorpe, 1992), appears to be consistent with the economic history of industrial nations.

As was forcefully argued by Kaelble (1985), this view of the role of corporations in economic development may help understand the transition from the early phase of capitalism (the "first industrial revolution"") to the later phase of "organized capitalism." Whereas the former phase is generally considered as one that has involved a globally negative (or at best neutral) effect on social mobility (to the extent that it heavily relied on small-size properties and firms that were essentially family-owned and therefore transmitted to future generations through inheritence), on the other hand the emergence of large corporations has coincided with a reduction of capital barriers, mainly through the rise of managerial careers and white-collar positions opened to non-owner business executives.[1] This evidence is somehow reinforced by historical European data on investments in formal education. These investments turned out to be of negligible quantitative importance until recently,[2] thereby suggesting that the positive evolution of social mobility during the late 19th century could hardly be attributed to the rise of a purely "educational meritocracy." Such empirical findings would point instead to a major role played by internal detection and promotions in enterprises. This paper takes as granted the role of

corporations in detecting and allocating talents in an economic environment where innate abilities are distributed independently from social origins but are not publicly observable. Specifically, we assume that one comparative advantage of corporations as compared to markets is <u>informational</u>: namely, through the direct monitoring of workers' performance, and even if this performance does not immediately translate into marketable products, large corporations

[1] What J. Goldthorpe (1992) refers to as "the apparent rise of meritocracy implied in fact by market forces and technological changes."

[2] 2.5% of 1910 European cohort attended some secondary education, 3.5% of a 1950 European cohort attended some higher education (see Kaelble (1985)).

can detect, reveal and promote talented workers. In doing so, corporations act as information producers and at the same time creating opportunities for social mobility that affect the distribution of occupations in the economy. This paper is concerned with the macroeconomic performance and implications of this mechanism through which corporations produce information about individual talents.

The main ideas emerging from the simple formalisation introduced in Section 2 can be summarized as follows:

(a) Given that the type of information produced depends on the technology currently adopted, technological choice involves an informational externality: typically, profit- maximization leads to too rapid a rate of technological change, since managers go for more skill-intensive technologies as long as they can adapt, even if fewer and fewer agents are detected today to form tomorrow's managerial elite (i.e. managers do not appropriate the social gains of information production). The rate of technological change is too rapid in the sense that total output could be higher with a lower rate, and income inequality increases continuously along such a "technological escalation" path.[3,4]

(b) In particular, the availability of too sophisticated (skill-intensive) technologies imported from the developed world might sometimes inhibit corporate promotions and therefore social mobility and macroeconomic development in less developed countries. The possibility of such a negative externality between the technological innovation and recycling processes initiated in "the North" and the process of economic development in "the South" mitigates the positive learning-by-doing externalities emphasized by many authors, including Young (1991) and Lucas (1993). It

[3] Recent empirical research on the huge increases in wage and income inequality of the past twenty years often attributes this "rise in returns to skill" to "biased technological progress" (see, for example, Juhn-Murphy-Pierce (1993)). Our mechanism suggests how market-driven technological change can at the same time increase inequality and be harmful from an aggregate output viewpoint.

[4] In the other extreme case with technology-specific talents, market forces lead to technological inertia.

seems nevertheless to be supported by anecdotal evidence from several LDCs.[5]

(c) When combined with the existence of a (rudimentary) informal sector, the above informational externality can account for the existence of multiple steady-state equilibria: one of them corresponding to a large corporate sector and therefore to a higher rate of social mobility and to higher wages; another equilibrium exhibiting a large "informal" sector of self-employed (or unemployed) individuals, with a resulting low rate of talent promotion: too few promotions in the past (that is, too little information accumulated) imply a low demand for manual workers, a low wage rate and little incentive for young agents to enter organizations, and thus little information production today. This latter equilibrium situation corresponds to what we call a "low-mobility" trap; wealth redistribution policies turn out not to be fully effective in getting rid of this occupational and informational trap, (because information rather than wealth is the key state variable of the accumulation process); on the other hand, subsidizing corporations' promotion activities through taxes, say on entrepreneurial income, may help overcome the trap and even lead to Pareto- improvements. This, possibly combined with (b) (the trap only exists if the technology is too skill-intensive as compared to the current size of the managerial elite), can explain the persistence of overwhelming, low-productivity informal sectors in many LDCs.

The existing economic literature that appears to be most closely related to the present work is twofold: it first consists of a handful of contributions about the impact of wealth inequalities on occupational choice and economic development (Aghion-Bolton (1993), Banerjee-Newman (1993), Galor-Zeira (1993), Piketty (1992)). These papers highlight various kinds of development traps

[5]Such evidence includes, for example, the disastrous effects that the early adoption of computerized irrigation systems (produced in countries like France) have had on the development of southern countries like Nigeria. Another example is the premature setting-up of petrochemical industries in Indonesia in the 1960s that have since been abandoned. Also, the hasty adoption of ultra-sophisticated technologies by oil producers such as Iran or Algeria has not produced the desired impact on the development of those countries, quite the contrary.

related to distributional dynamics. In all these models, individuals share identical abilities, and therefore occupational trajectories are exclusively dictated by initial wealth endowments and credit constraints. By contrast, our framework is one with heterogeneity in the distribution of talents across individuals and our emphasis is on how various kinds of industrial environments perform in detecting and promoting talents that cannot be directly promoted through capital markets or credit-financing. This allows us to introduce information-accumulation as a key variable of the development process, thereby explaining why acting on wealth accumulation may not be sufficient to ensure growth and development.

Also related to our analysis is the microeconomic literature on organizations, hierarchies and promotions [Calvo-Wellisz (1979), Rosen (1983), Bernhardt (1991), Meyer (1991), Prendergast (1991), ...]. As in our model, the most talented individuals tend to be allocated to higher hierarchical layers. In the first two papers, however, talents are publicly observable so that the entire problem of detection and promotion becomes irrelevant. On the other hand, the latter three papers consider situations in which firms learn about their employees' abilities (as we do in this paper), but their focus is on the microeconomic analysis of information revelation[6] and not on macroeconomic development issues.

The paper is organized as follows: Section 2 outlines the basic model and characterizes its steady-state equilibrium. Section 3 endogenizes the choice of technology by private corporations, analyzes its impact on social mobility and aggregate output and proposes a corrective tax/subsidy scheme. Section 4 investigates the multiplicity of steady-state equilibria and the existence of low-mobility traps where corporate activities are discouraged by the existence of a very large informal sector. Section 5 concludes.

[6] For example, the implementation of "fast-track policies" is being explained by this recent "labor-micro" literature, either by the fact that such policies can increase the value of information firms acquire about their employees' abilities; (Meyer (1991)); or because they provide incentives for good workers to acquire further training (Prendergast (1991)); or because fast-track policies enable the firm to take advantage of its private information in order to minimize the total wage bill over time.

2 The Model

2.1 Population

There is a large population (a continuum) of agents with identical preferences: the distribution of wealth at time $\tau = 1, 2, \ldots$, is represented by a distribution function $F_\tau(w)$ which measures the population with wealth less than w (up to section 4.2., we assume first-best efficient capital markets, so that the wealth distribution is irrelevant).

Each agent is characterized (apart from his current wealth) by his talent $t \in \mathbb{R}^+$; t is a complete summary of his general innate ability, which includes intelligence, energy, physical ability and other valuable traits which affect how well he operates the production technology.[7] (Talents can be technology-specific or non-technology-specific; see Section 3). The basic postulate is that these talents are distributed independently from social origins (that is, from inherited wealth); specifically, we assume that they are randomly and uniformly distributed over $[0, 1]$ (for any interval $[w; w']$ the proportion of agents with inherited wealth between w and w' and with talent less than t is t).

Each agent's lifetime lasts for two periods. At the beginning of his first lifetime period, the agent receives his initial wealth in the form of a bequest from his parent. During each period of his lifetime he chooses an occupation, invests his wealth, possibly applies for a loan, works and consumes. At the end of his lifetime he gives birth to a child and bequeaths to him. The measure of each generation is equal to 1, that of total population is stationary and equal to 2.

Agents are risk-neutral: preferences over commodities are represented by $u = pc^\alpha b^{1-\alpha} - \ell$, where c is an agent's total lifetime consumption (there is only one physical good in the economy), b is the amount left as a bequest to his offspring,[8] and ℓ is the total lifetime amount of labor he supplies (at each

[7] As mentioned in Section 1, we are primarily concerned with a world where innate talents and not education investments play the major role in determining total ability (or, equivalently, where education provision shifts the distribution of talents upward uniformly). For a brief discussion of the case in which total ability is the sum of innate talent and private education investment, see Section 5.

[8] The "warm glow" (Andreoni (1989)) is much more tractable than other bequest motives.

lifetime period labor supply = 0 or 1, so that ℓ is the number of periods during which he is active). $p = \alpha^{-\alpha}(1-\alpha)^{\alpha-1}$, so that if total (expected) income is y, utility takes the form $y - \ell$.

2.2 Technology

Two technologies are available in the economy, leading to various occupational possibilities: self-employment and manual work within, or management of, firms.

Self-employment uses a low-productivity technology characterized by an initial investment k_s and a stochastic gross return $\tilde{y}_s$: an agent who chooses to be self-employed invests k_s, the outcome of which is the random variable $\tilde{y}_s$: for simplicity we assume $\tilde{y}_s = y_s$ with probability q and $\tilde{y}_s = 0$ with probability $1-q$. (We essentially ignore this technology until Section 4.)

Large-scale technology (the firm) requires several agents to be productive: by investing $k_F(> k_S)$, μ agents working as production workers (say, manual workers) and one agent with talent t working as a manager can produce $y_F(\mu) = y_F f(\mu)$ with probability $p(t)$ and 0 with probability $1 - p(t)$, where $f(\mu)$ is a concave, increasing real mapping, $p(t)$ maps talents into $[0;1]$, and $f(0) = 0$.[9] The manager performs supervisory functions, but also engineering, marketing and other tasks which are necessary to make the output marketable; without the manager's contribution manual workers' output is of no worth (and in particular is not marketable).

For simplicity, we will assume that there exists $\theta, p_1, p_2 \in [0;1]$, $p_1 < p_2$, such that:

$$\begin{aligned} p(t) &= p_1 \quad \text{for } 0 \leq t < 1-\theta, \\ p(t) &= p_2 \quad \text{for } 1-\theta < t \leq 1. \end{aligned}$$

Figure 1 here.

[9] For simplicity we assume here that talent only matters when one acts as a manager: this is an extreme form of the general principle that talent matters more at higher hierarchical levels (as analyzed, among others, by Calvo and Wellisz (1979), Rosen (1983) and Kremer (1993)). Nothing qualitatively essential would be changed by switching to a less extreme form of this principle.

Thus for a given large-scale technology there exist two types of agents: low- ability agents and high-ability agents. The parameters $k_F, f(\mu), p_1$ and p_2 are fixed, and a large-scale technology is characterized by a pair (y_F, θ): a technology characterized by a lower θ and a higher y_F is more productive but requires more demanding skills (only a fraction θ of the population is appropriately able to operate it).

We assume that y_F is sufficiently large that, at least when the wage rate takes its minimum level $\nu = 1$, it is profitable for a high-ability agent to operate the large-scale technology and that p_1 is sufficiently small that it is never profitable for a low-ability agent to do so (here we do not take into account the existence of a self-employment technology):

$$\begin{array}{ll} \textbf{A1}: & \text{If } \nu = 1, \ \max_{\mu \geq 0} \ p_2 y_F f(\mu) - \mu\nu - k_F > \nu. \\ \textbf{A2}: & \text{If } \nu = 1, \ \max_{\mu \geq 0} \ p_1 y_F(\mu) - \mu\nu - k_F < \nu. \end{array}$$

The realizations of returns from both technologies are randomly and independently distributed across the economy, so that production activities carry no aggregate uncertainty.

The assumptions spelled out so far would be enough to compute the first-best efficient outcome of the economy: allocate talents to occupations and technologies so as to maximize total output (assuming that technologies are sufficiently productive to match the individuals' labor opportunity cost equal to 1). However the allocation process takes place within an imperfect system of markets with substantial informational limitations, which we now describe.

2.3 Markets and Information

The basic informational assumption is that talents are not publicly observable:[10] At the beginning of an individual's lifetime, the only information available about his talent (for outside observers as well as for the agent himself) is the uniform prior over [0; 1]; his expected probability of success is therefore defined by $p_0 = (1 - \theta)p_1 + \theta p_2$.

[10] One possible justification is that if natural talents were publicly observable, productive efficiency would require much higher rates of intergenerational social mobility than those we typically observe.

We assume that during each production period some information about workers' ability is produced: at the end of one production period it is publicly known whether a worker is a high-ability type or a low-ability type for the technology (y_F, θ) which is being used.[11] We admit that this information structure is special, but we believe it captures the main features of the informational advantage of corporations that interests us most. Alternatively, we could have assumed that managers do privately learn about their workers' talents (presumably through their intensive supervision and control activities): if promotion offers are publicly observable however, the resulting equilibrium would be equivalent to that obtained in the public-information case (i.e. managers would capture no informational rent from this informational advantage).[12]

The labor market (that is, the market for manual workers) is perfectly standard: occupational choice (i.e. who decides to be a worker and who decides to be a manager) determines demand and supply of manual workers, which in turn determines the equilibrium wage rate ν.[13]

Until section 4.3 we assume the credit market to be first-best efficient (i.e. no monitoring or tracking costs are involved).

We can now study the dynamic equilibrium of the economy and the various occupational and social-mobility patterns which naturally emerge.

2.4 Occupations, equilibrium and steady states

Ignoring the self-employment technology, there are at most four possible social states in the lifetime of any individual: young worker (YW), old worker (OW),

[11] It may seem odd to assume that information is produced about talents which do not directly affect the productivity of workers; as noted in footnote 5, however, removing this technological assumption would not dramatically change the model.

[12] In this case, however, one may assume that some firm-specific human capital is being revealed as well in which case managers can appropriate some positive rent. For example if workers' productivity is scaled up by a factor $(1+\lambda)$ in case they are promoted in the same firm, then managers capture a fraction $\frac{\lambda}{1+\lambda}$ of promoted workers' output; as λ goes to 0 the equilibrium obtained boils down to that obtained in our model). In any case, the main element driving all our results is that managers do not capture the full social returns from the public information they generate through promotion activities.

[13] Since manual workers' labor supply exhibits no moral-hazard problem and since there is no aggregate uncertainty, manual workers obtain a safe wage.

young manager (YM), and old manager (OM).

We now show how social-mobility patterns and occupational dynamics depend entirely on the characteristics (y_F, θ) of the large-scale technology. For example, assume that (y_F, θ) is a fairly primitive technology, i.e. that y_F is relatively low and that the managers' task consists of a pure monitoring activity that everybody can perform equally well ($\theta = 1$). In equilibrium, managerial profit must be equal to the wage rate so as to make every agent (young or old) indifferent between both occupations. In such a world, the notions of social mobility or promotions are bound to be empty.[14]

If the technology becomes more advanced (i.e., y_F goes up and θ goes down),[15] then it becomes profitable for high-ability workers to be detected by their current emploeyers and thereby socially promoted. In equilibrium the managerial population is a mixture of agents with average ability p_0 who become owner-managers through inheritance and of non-owner managers with ability p_2 who started their career as manual workers. This evolution mimics roughly that of social mobility in western societies along with the industrialization process (as described by Kaelble (1985)). Obviously, this evolution is favored by having a more developed credit market.

As θ decreases family-transmitted management careers become less likely, and completely disappear when θ falls below $\hat{\theta}$ defined by:[16]

$$\max_{\mu \geq 0}(p_1 + \hat{\theta}(p_2 - p_1))y_F f(\mu) - \mu - k_F = 0.$$

[14] Note, however, that any positive amount of credit-market imperfection would imply that wealthy people become managers and poor people become workers (i.e. occupations are transmitted through inheritance): for example if there is a fixed cost Q to access the credit market, the equilibrium wage rate will (in general) satisfy

$$\begin{array}{lcl} \max_{\mu \geq 0} p_2 y_F f(\mu) - \mu\nu - k_F & > & \nu, \\ \text{and} & & \\ \max_{\mu \geq 0} p_2 y_F f(\mu) - \mu\nu - k_F - Q & < & \nu. \end{array}$$

so that poor agents ($w < k_F$) become workers and wealthy agents ($w > k_F$) become managers. Some implications of credit-market imperfections for economic development are investigated in Section 4.2 below.

[15] Note that this pattern of technology is typically generated by competitive technological choice along a technological frontier (see section 3.2).

[16] The exact threshold is above $\hat{\theta}$ and depends on the current wage rate $\nu \geq 1$.

Assumption A2 implies that $\hat{\theta} > 0$. If $\theta < \hat{\theta}$ even a very wealthy individual cannot become a manager if he is not known to be of a high-ability type. In that case, only those individuals who have been promoted will become managers. We shall concentrate on this case in order to better illustrate the promotion mechanism.[17]

Thus, from now on we assume:

A3: $\theta < \hat{\theta}(y_F)$.

When the market wage rate is equal to ν a promoted manager will choose to hire $\mu(\nu)$ workers so as to maximize profit:

$$\mu(\nu) = \arg\max_{\mu \geq 0} p_2 y_F f(\mu) - \mu\nu,\ y_F(\nu) = \max_{\mu \geq 0} p_2 y_F f(\mu) - \mu\nu.$$

The transitional dynamics is straightforward: everybody starts as a YW. a fraction θ is detected and becomes OM and a fraction $1-\theta$ becomes OW. To summarize:

$$\left[\begin{array}{rcl} YW_\tau & = & 1, \\ OM_{\tau+1} & = & \theta YW_\tau, \\ OW_{\tau+1} & = & (1-\theta)YW_\tau. \end{array}\right.$$

Proposition 1. *In steady state,the social structure is* $(YW_\infty = 1; OW_\infty = 1-\theta; OM_\infty = \theta)$, *the social-mobility rate is* θ, *the wage rate* $\overline{\nu}_\infty$ *is given by* $\overline{\nu}_\infty = \mu^{-1}\left(\frac{2-\theta}{\theta}\right)$ *total output* $\overline{Y}_\infty$ *is given by* $\overline{Y}_\infty = \theta\left(p_2 y_F f\left(\frac{2-\theta}{\theta}\right) - k_F\right)$. *Both* $\overline{\nu}_\infty$ *and* Y_∞ *are increasing with* θ *(and* y_F*).*

3 Technological Choice and Production of Information

Thus using a technology (y_F, θ) not only produces output at the end of the period, but also produces information: one production period reveals who is able to work at the higher hierarchical level. The key point is that the

[17] Our main conclusions, in particular, those regarding the existence of a low-mobility trap and the impact of technological choice would only be reinforced by having rich managers $(\theta > \hat{\theta})$.

information produced depends on the technology (y_F, θ) which is being used, so that choosing a technology also means choosing a learning potential, and therefore involves an informational externality. We now analyze how private managerial incentives fail to internalize correctly this information-production aspect of technological choice.

Technological knowledge is represented by a set of technologies (y_F, θ) satisfying assumptions A1, A2 and A3 (that is, high-ability agents can efficiently operate a technology as managers, but those of average-ability or low-ability cannot). In equilibrium technologies always belong to the technological frontier, which is a downward-sloping curve $y_F(\theta)$ (if there exists a technology with at the same time a higher productivity y_F and a higher fraction θ of appropriately able agents, then the choice is obvious). As shown in section 2.4, total output in the steady state associated with a technology $(\theta, y_F(\theta))$ is given by:

$$Y_\infty(\theta, y_F(\theta)) = \theta\left(p_2 y_F(\theta) f\left(\frac{2-\theta}{\theta}\right) - k_F\right).$$

Therefore the second-best,[18] socially optimal tradeoff[19] between a higher productivity and a smaller managerial elite leads to a unique θ^* given by:

$$\theta^* = \arg\max_\theta \; \theta\left(p_2 y_F(\theta) f\left(\frac{2-\theta}{\theta}\right) - k_F\right).$$

This is the technology that a benevolent social planner would choose. As we now see, it is different from the technology implied by market forces and competitive equilibrium. We distinguish the cases of technology-specific talents and non-technology specific talents, and then analyze corrective tax/subsidy schemes.

[18] "Second-best" in the sense that the social planner has to take into account that whatever the technology individuals can be managers only during their second lifetime period, after their ability type has been detected in the corporations. This differs from the "first-best" technology that a planner observing directly innate skills would choose.

[19] We assume that occupation-contingent transfers can be used in this economy, so that "social optimality" reduces simply to output maximization.

3.1 Technology-specific talents: technological inertia

We say that talents are technology-specific if there is no correlation between being a high-ability type for a technology (y_F, θ) and being a high-ability type for another technology (y'_F, θ'). Therefore an OM who has been detected as smart on a technology (y_F, θ) keeps *a priori* the same average probability of success p_0 with any other technology (y'_F, θ'). Since assumption A3 implies that an agent with average-ability cannot make a positive profit by operating a technology as a manager, it follows that an individual who has been promoted while working as a manual worker with a particular technology (y_F, θ) will always end up operating the same technology (y_F, θ) as a manager. Therefore the long-run technology and steady state are entirely determined by initial conditions: if initially some technologies are operated by appropriately able managers, then these technologies will persist and no new technology is ever adopted. In other words, whatever type of information was produced yesterday determines which technology is used today, and therefore which type of information will be produced today.

Proposition 2. *If talents are technology-specific and if all available technologies satisfy A1, A2, A3, then any technology can be sustained in equilibrium.*

Such a world is thus characterized by complete technological inertia: once a technology has been adopted in the past, the replacement cost is so high that no private incentive is sufficient to induce a technological change.

3.2 Non-technology-specific talents: technological escalation

Talents are non-technology-specific if the talents t are the same for every technology; that is, if someone is known as a high-ability agent for a technology (y_F, θ), his updated probability of success on a technology (y'_F, θ') is given by:

$$\begin{aligned} p(\theta', \theta) &= p_2 \text{ if } \theta' > \theta, \\ p(\theta', \theta) &= p_2 \tfrac{\theta'}{\theta} + p_1 \left(1 - \tfrac{\theta'}{\theta}\right) \text{ if } \theta' < \theta. \end{aligned}$$

Therefore a YM who has been detected on a technology $(y_F(\theta_\tau), \theta_\tau)$ at period τ will choose at period $\tau+1$ a technology $(y_F(\theta_{\tau+1}), \theta_{\tau+1})$ that maximizes its expected conditional profit:

$$\theta_{\tau+1}(\theta_\tau) = \arg\max_{\theta,\mu} p(\theta, \theta_\tau) y_F(\theta) f(\mu) - \mu\nu = \arg\max_{\theta} p(\theta, \theta_\rho) y_F(\theta).$$

It is straightforward to see that $\forall \theta_\tau \geq 0$, $\theta_{\tau+1}(\theta_\tau) \leq \theta_\tau$: there is no interest for someone whose talent t is above $1-\theta_\tau$ to adopt a less demanding technology than θ_τ, since the consequence would be to increase the probability of detecting able agents (which is of worth for the promoter) and to decrease the return $y_F(\theta)$ (which diminishes profit). It follows that starting with some technology $(y_F(\theta_\tau), \theta_\tau)$ the economy will follow a technological escalation, in the sense that managers will adopt more and more advanced technologies which can be operated by fewer and fewer agents. Thus there are two possibilities: either the escalation stops at some θ^e such that $\theta_{\tau+1}(\theta^e) = \theta^e$, or it does not stop. Given some technology θ_τ, $\theta_{\tau+1}(\theta_\tau) < \theta_\tau$ if and only if the increased productivity involved in choosing a more sophisticated technology counterbalances the resulting private loss in (expected) ability, i.e., ifand only if

$$\left.\frac{d}{d\theta}\left[p(\theta, \theta_\tau) y_F(\theta)\right]\right|_{\theta=\theta_\tau^-} < 0,$$

$$\left[\text{that is, } \frac{p_2 - p_1}{\theta_\tau} y_F(\theta_\tau) + p_2 y_F'(\theta_\tau) < 0.\right]$$

If adopting more and more skill-intensive technologies does not lead to infinitely high private returns (say, if $y_F(\theta)$ is bounded above as θ goes to 0), then there exists $\theta^e > 0$ such that $\theta_{\tau+1}(\theta^e) = \theta^e$, or equivalently:

$$\frac{p_2 - p_1}{\theta^e} y_F(\theta^e) + p_2 y_F'(\theta^e) = 0.$$

However if the technological frontier $y_F(\theta)$ is so steep that:

$$\lim_{\theta \to 0} \frac{\theta y_F'(\theta)}{y_F(\theta)} < -\frac{p_2 - p_1}{p_2}, \tag{1}$$

then there does not exist such a θ^e, and the technological escalation never stops.

Proposition 3. *Assume talents are non-technology-specific. If (1) holds, then* $\theta_\tau \to 0$ *as* $\tau \to \infty$ $\forall \theta_0 > 0$. *Otherwise, there exists* $\theta^e > 0$ *such that if* $\theta_0 > \theta^e$, $\theta_\tau \to \theta^e$ *as* $\tau \to \infty$, *and if* $\theta_0 < \theta^e$, $\theta_\tau = \theta_0$ $\forall \tau \geq 1$.

3.3 Market failure and a corrective subsidy

It is straightforward from Propositions 2 and 3 that the technologies sustained in competitive equilibrium do not coincide in general with the socially- optimal technology $(\theta^*, y_F(\theta^*))$. In particular it may well be the case that competitive incentives lead to the adoption of infinitely skill-intensive technologies in the long run $(\theta_\tau \to 0)$ even though such technological choice implies a complete collapse of total output: for example if $y_F(\theta) \sim 1/\sqrt{\theta}$ for θ small, then $\dfrac{\theta y_F'(\theta)}{y_F(\theta)} \sim -\dfrac{1}{2}$, so that Proposition 4 tells us that if $p_1 > p_{2/2}$, $\theta_\tau \to 0$ as $\tau \to \infty$ in competitive equilibrium. Such an unbounded technological escalation would be socially harmful because aggregate output $Y(\theta, y_F(\theta)) \sim \theta y_F(\theta) f\left(\frac{2-\theta}{\theta}\right) \to 0$ as $\theta \to 0$; if, for example, $f(\mu) = \mu^\alpha$ with $\alpha < \frac{1}{2}$. That is, the continuous increase in managerial productivity is more than counterbalanced by the fact that fewer and fewer individuals can be managers. Managers do not internalize this complete collapse of the economy because they are only concerned with their private profit and not with the number of managerial careers they can potentially generate.

One can think of several reasons why private contracting cannot deal correctly with this inefficiency in technological choice: first, in modern legal systems individuals cannot generally commit their future human capital (that is, they cannot commit not to leave once promoted as a way to induce their managers to internalize the benefits from their promotions).[20] Second, note that we implicitly assumed that workers do not observe the technology (y_F, θ) used by the manager employing them: otherwise they could have accepted to work for a lower wage rate $\nu(\theta)$ on a technology with a higher rate θ of upward career mobility (this would be equivalent to creating a market for information about individual abilities).

[20] This is the limitation to private contracting referred to by Hart and Moore (1991) as the "inalienability of human capital."

Although the assumption that only managers know the learning potential of the technology they are using does not seem unrealistic to us, it is crucial to recognize that even if workers had this information, any private-contracting solution to the externality problem would in practice be severely limited by the existence of a lower-bound $\underline{v}$ on the wage schedule $v(\theta)$: this $\underline{v}$ may be imposed either by liquidity constraints and credit-market imperfections or efficiency-wage considerations.

The inefficiency in technological choice is entirely due to the fact that managers do not internalize the social benefits of promotions. Therefore a natural corrective public intervention consists of subsidizing promotions: assume that the government commits to transfer a fraction s of every PM's profit to the promoter's dynasty and to finance this subsidy by a tax at rate T on managerial profit (in steady-state, budget-balancedness implies $T = s$). For simplicity, consider the case of technology-specific talents. Define $\theta(T, s)$ to be the technological skill-intensity which maximizes the income of a would-be manager when a tax/subsidy scheme (T, s) is applied to him:

$$
\begin{aligned}
\theta(T,s) &= \arg\max_\theta \left(1 - T + s\mu(\theta,\nu)\theta\right) y_F(\theta,\nu), \\
\text{with } \mu(\theta,\nu) &= \arg\max_\mu \left(1-T\right)\left(p, y_F(\theta) f(\mu) - \mu\nu\right) + \mu\theta y_F(\theta,\nu) \\
y_F(\theta,\nu) &= y_F(\theta) f(\mu(\theta,\nu)) - \mu(\theta,\nu)\nu \\
\text{and } \mu(\theta,\nu)\theta & \quad \text{is the expected number of promotions.}
\end{aligned}
$$

As we saw in Section 3.1 above, an individual who has been detected as smart while working on the technology $(\theta(T, s), y_F(T, s))$ will find $\theta(T, s)$ privately optimal. $\theta(T, s)$ is an increasing function of T and s (managers have more incentives to choose a technology that generates more promotion opportunities the higher the subsidy to promotions and/or the tax on private profit). If $T = s = 1$ (that is, if profits are completely shifted from promoted managers to promoters via the tax system), managers will obviously choose a $\theta(T, s)$ as high as possible (in other words, they will minimize the level of technological sophistication). Therefore there exists a unique tax/subsidy rate

$T^{\star} = s^{\star} \in [0:1]$ such that

$$\theta(T^{\star}, s^{\star}) = \hat{\theta}.$$

Proposition 4. *There exists a tax/subsidy scheme* $(T^{\star}, s^{\star})$ *implementing the socially-efficient technology.*

In an identical manner, one can prove the existence of such a tax/subsidy scheme in the case of non-technology-specific talents.

4 The Informational Development Trap

So far, agents had no choice but to enter the large-scale sector. We now consider a two-sector economy in which the large-scale, information-producing sector with a fixed technology (y_F, θ) coexists with a self-employment sector. This, in turn, introduces two additional social states to the analysis: young self-employed (YSE) and old self-employed (OSE). One can think of self-employment as representing rudimentary, non-capital intensive services or subsistence activities. In particular, we shall assume that the net expected return to self-employment $qy_s - k_s$ is smaller than the wage rate $\overline{v}_{\infty}$ in the steady-state equilibrium in Section 2.4 (so that the latter remains a steady state when agents have the option to be self-employed):

A4: $\quad qy_s - k_s < \overline{v}_{\infty} = p_2 y_F f'\left(\frac{2-\theta}{\theta}\right).$

In this section, we investigate the existence of additional (low-mobility) equilibria where an insufficient information about talents being accumulated in the past makes it less attractive for young individuals to enter the corporate sector (the small number of [promoted] managers implies limited prospects for promotion and low wages for entering workers). As a result, most newly-born individuals will choose self-employment, and therefore little information is generated about this generation's distribution of talent. This, in turn, may prevent the economy from converging to the high output, high-information steady-state characterized in Section 2.4.

It turns out that history-dependence and steady-state multiplicity of the kind just described [namely with a high output equilibrium involving a large

corporate sector, and a "low-mobility trap" induced by the persistence of a large (and absorbing) self-employment or informal sector] can result either from the existence of size-effects in the detection technology (Section 4.1) or from credit-market imperfections (Section 4.2). In both cases we shall discuss the scope for government intervention aimed at facilitating the transition from the low-output steady-state (the "trap") to the high-output steady state (the "corporate society").

4.1 Size effects in the production of information

So far we have assumed that all high-ability agents were detected during one production period. Assume now that when a manager employs μ workers there is a probability $\varphi(\mu) \leq 1$ that a high-ability worker will be detected. It seems realistic to assume that $\varphi(\mu)$ is a decreasing function of μ: more information per worker is produced when the firm is relatively small with a high manager-to-worker ratio.[21]

Now, if no one ever enters the informal sector, maximal information accumulation takes place and in steady-state we have:

$$\left[\begin{array}{lcl} YW_\infty & = & 1, \\ OM_\infty & = & \theta\, \varphi\left(\frac{YW_\infty + OW_\infty}{OM_\infty}\right) = \theta\varphi(\underline{\mu}), \\ OW_\infty & = & 1 - \theta\ \ \varphi\left(\frac{YW_\infty + OW_\infty}{OM_\infty}\right) = 1 - \theta\varphi(\underline{\mu}). \end{array}\right.$$

so that firms' size, $\underline{\mu}$, is given by $\theta\ \varphi(\underline{\mu})(1+\underline{\mu}) = 2$:

$$\underline{\mu} = \frac{2}{\theta\varphi(\underline{\mu})} - 1.$$

and the wage rate, $\underline{v}$, is equal to $p_2 y_F f'(\underline{\mu})$. This steady state exists if and only if this wage rate is higher than the net expected return to self-employment:

[21] This is particularly true if managers have limited time or attention to devote to detection activities, given that they do not appropriate the full corresponding returns. Then, the larger the span of control, the less attention or detection efforts will be devoted to each worker, and therfore the smaller the probability of detecting and promoting the best workers. Put another way, the probability of a "type-two" error per worker will typically increase with the worker-to-manager ratio.

A4': $p_2 y_F f'(\underline{\mu}) > q y_s - k_s$,

which is nothing but the exact equivalent of our condition A4.

Now, can we find some additional conditions under which there also exists a low- mobility, low-output steady-state equilibrium, where the bulk of the working class would decide to become self-employed instead of entering the corporate sector? Such an equilibrium would typically have a fraction of the young individuals (weakly) prefer to work as self-employed, which in turn implies that all the old individuals to whom the corporate sector does not offer any promotion prospect would strictly prefer to also become (or remain) self-employed. Let $y < 1$ denote the fraction of young individuals that choose to enter the corporate sector in such a steady-state equilibrium. We then have:

$$\begin{aligned} YW_\infty &= y, \\ OM_\infty &= y\theta\varphi(\overline{\mu}), \\ SE_\infty &= 1 - y + 1 - y\theta\varphi(\overline{\mu}), \end{aligned}$$

where $\overline{\mu} = y / y\theta\varphi(\overline{\mu})$is the workers/ manager ratio in equilibrium. [There are no old workers since all unpromoted individuals prefer to become self-employed, and therefore the informal sector absorbs all those individuals who are neither young workers nor (old) managers in the corporate sector.]

A sufficient condition for the existence of such a low-mobility trap is that the corresponding equilibrium wage $\underline{v}_\infty$ be sufficiently small that the old unpromoted individuals will indeed disregard the corporate sector and decide instead to become unemployed.[22] This will be the case if and only if:

A5: $\underline{v}_\infty = p_2 \cdot y_F \cdot f'(\overline{\mu}) < q y_s - k_s$.

Now for the two steady-state equilibria (respectively with high and low mobility rates) to coexist for a non-empty set of parameter values $\{p_2, y_F, q, y_s, k_s\}$

[22] For y to be strictly positive in equilibrium, it must be the case that young individuals are indifferent between entering the corporate sector or becoming self- employed. More formally, it must be the case that:

$$2 - \theta\varphi(\overline{\mu}))\underline{v}_\infty + \theta\varphi(\overline{\mu})\pi(\underline{v}_\infty) = q y_s - k_s.$$

This in turn imposes an additional condition on the parameters (q, y_s, k_s) or, put differently, for almost all triplets (q, y_s, k_s) the corporate sector will simply disappear in a low-mobility-trap equilibrium.

it suffices that:

$$f'(\overline{\mu}) < f'(\underline{\mu}), \text{ i.e. } \overline{\mu} > \underline{\mu},$$

(so that there exists parameter values for which A4' and A5 hold simultaneously), where

$$\overline{\mu} = \frac{1}{\theta\varphi(\overline{\mu})}$$

and

$$\underline{\mu} = \frac{2}{\theta\varphi(\underline{\mu})} - 1.$$

It turns out that the above condition is never satisfied when the size effect measured by $|\varphi'(\mu)|$ is sufficiently small one can actually show that the above high-mobility equilibrium is the unique steady-state equilibrium of the economy.

Figure 2 here.

On the other hand, if the detection rate $\varphi(\mu)$ decreases sufficiently steeply with μ, gross informational output will decrease with firms' size which graphically translates into both curves $\frac{1}{\theta\varphi(\mu)}$ and $\frac{2}{\theta\varphi(\mu)} - 1$ having slopes bigger than 1 (Figure 2). In that case we indeed obtain $\underline{\mu} < \overline{\mu}$, and therefore the existence of a low-mobility trap for suitable parameter values.

Figure 3 here.

Proposition 5. *If $\varphi(\mu)$ decreases sufficiently steeply, the economy converges to the high-output steady state if initial information PM_O is large enough and converges to the low-mobility steady state otherwise.*

A natural interpretation for such a low-mobility trap at $\overline{\mu}$ is as follows: when the managerial elite is very small and there are strong decreasing returns to detection activities within corporate firms, very few defections and promotions will eventually take place in equilibrium; therefore the corporate sector remains unattractive, in particular to young and potentially talented individuals who prefer to become self-employed rather than prepare themselves for a possible managerial career in the future.

An interesting property of this low-mobility trap is that it cannot be removed through wealth redistribution policies (since the wealth distribution is irrelevant in the first-best capital market we have assumed so far). This distinguishes our low- mobility trap from other poverty and inequality traps recently analyzed by Galor and Zeira (1993), Banerjee and Newman (1993), Aghion and Bolton (1991) and Piketty (1992): in these studies the long-run steady-state depends entirely upon the initial distribution of wealth and therefore acting on the distribution through taxation and redistribution is sufficient to remove the "bad" steady states. By contrast, the steady-state distribution of occupations in our model depends primarily upon both the distribution of talents and the equilibrium rate at which talented individuals are being detected and promoted. However, the private managers' incentives to engage in detection and promotion activities turn out to be more sensitive to the choice of technology and/or to direct promotion subsidies (see Section 3 above) than to wealth redistribution policies that would not *a priori* induce more discrimination between talented and untalented individuals. This latter point should become clearer in the next subsection where wealth inequality and credit-constraint considerations are brought into the analysis.

How is it, then, possible to induce a transition from the low-mobility development trap to the high- mobility corporate society? Taking readily our highly-stylized model, a straight solution would be to tax the SE activity and to subsidize the corporate sector's detection activities $\varphi(\mu)$. In particular public education should contribute to a preselection of talents that would effectively complement and facilitate the detection activities directly undertaken by corporate firms. The result of such public intervention would be to reduce the size affect $|\varphi'(\mu)|$ and thus to increase the likelihood of a Figure 1-type situation where the possibility of a low-mobility trap equilibrium is simply eliminated.

Another solution would be for the government to act on the large-scale technology (y_F, θ) and to induce corporate firms to adopt a less advanced technology for some time, as a way to facilitate promotions and thereby favor the emergence of a larger elite of corporate managers, before possibly and progressively returning to more advanced technologies. In terms of our model,

increasing the parameter θ would reduce the slope of the curves $\frac{1}{\theta\varphi(\mu)}$ and $\frac{2}{\theta\varphi(\mu)} - 1$, thereby facilitating the transition to a high-mobility equilibrium. One should not push this latter kind of idea too far, however, and in particular suggest that technological backwardness is always a recipe for future economic development. On the other hand, the fact that in several Southeast Asian countries the maintenance of traditional organizational and technological patterns appears to have facilitated the achievement of high-growth development paths[23] remains a puzzle for most development economists.

4.2 Accumulation of information versus accumulation of wealth

Wealth distribution considerations did not play any role in our analysis so far: in the absence of credit-constraints, the occupational map was indeed completely determined by the distribution of talents, the technology, and by the individuals' expectations about the equilibrium rate of corporate promotions as a function of past corporate history. In this subsection, we introduce wealth considerations based on the existence of credit-market imperfections to our analysis of the low-mobility development traps; although various kinds of market imperfections, including the existence of informational asymmetries, would lead to similar qualitative results, we assume for simplicity that there exists a fixed cost Q to access the credit market. The consequence is that dynamic occupational choice is going to depend on the distribution of wealth (and not only on information about talents).

In order to keep the analysis as close as possible to that in the preceding sections, we still assume that when the wage rate takes its minimum level $\nu = 1$, it is profitable for a high-ability agent to operate the large-scale technology and that p_1 is sufficiently small that it is never profitable for a low-ability agent to do so (here we do not take into account the existence of a self-employment

[23] A case in point appears to be the People's Republic of China, where productive methods have remained quite traditional until the early 1980s, in the mean time a considerable investment effort was being made and sustained in general public education.

Both elements, even though initially motivated by ideological and political considerations, seem to have somehow positively contributed to the subsequent growth records of the late 1980s and early 1990s.

technology):

$$\mathbf{A1'}: \quad \text{If } \nu = 1. \quad \max_{\mu \geq 0} p_2 y_F f(\mu) - \mu\nu - k_F - Q > \nu.$$

$$\mathbf{A2}: \quad \text{If } \nu = 1, \quad \max_{\mu \geq 0} p_1 y_F(\mu) - \mu\nu - k_F < \nu.$$

In other words, the credit cost Q does not affect the decision of whether or not to become a corporate manager; it will only affect the decision of whether to become a self-employed rather than a corporate worker.

In the remaining part of this subsection we shall try to derive sufficient conditions on the parameters $\{y_F, q, y_s, k_s, Q, \ldots\}$ under which the high-mobility (steady-state) equilibrium in Sections 2 or 4.1 coexists with a low-mobility trap where the corporate take-off is (partly) deterred by the (overwhelming) informal sector. Two different kinds of low-mobility traps, both driven by the existence of credit constraints, will be considered in turn:

(a) In the first kind of a trap, the combination of credit constraints with the fixed cost k_s of entering the informal sector forces the poor individuals to initiate their career as workers in the corporate sector. This, together with an insufficient demand for manual workers by [the small number of] corporate managers, pushes the equilibrium wage down to such a low level that only those agents who are too poor to become self-employed end up becoming manual workers in the corporate sector.

(b) In the second type of low-development trap, it is the existence of a fixed (education or training) cost of entering the corporate sector which, together with low promotion prospects, maintains (and reproduces) an overwhelmingly large informal sector.

Both traps illustrate the kind of perverse dynamics emerging from the dual accumulation of wealth and information: the trap would not exist if wealth accumulation were irrelevant (see Section 4.1 with $\varphi(\mu) \equiv 1$). However, we shall see why acting directly on information accumulation may be the only way out of the trap.

4.2.1 A low-mobility trap where the poor are forced into the corporate sector

Consider the following two inequalities:

$$qy_s - k_0 - Q < \nu. \tag{2}$$

$$qys - k_s + q(qy_s k_s) + (1-q)\nu > \nu + \theta(y_F(\nu) - k_F - Q) + (1-\theta)\nu. \tag{3}$$

Inequality (1) says that borrowing to become SE is not worth it (i.e. the net return is smaller than the wage rate), whereas inequality (2) that when no loan is necessary to become SE the NPV of becoming SE (with the risk $1-q$ of being a poor worker in period 2) is higher than the NPV of entering organizations (recall that there is no discount rate). Then agents with current wealth below k_s have no choice but to work in the large-scale sector, whereas agents with current wealth above k_s always prefer to become SE. In order to describe the transitional dynamics, one whould in general distinguish between different kinds of agents with wealth $w > k_F$ (respectively $w < k_F$) depending on how many consecutive failures (respectively successes) make them switch down below k_F (respectively above k_F). For simplicity, however, we assume that the consumption rate α is high enough and the SE sunk investment k_s appropriately bounded below and above so that (in the long-run): unlucky OMs and SEs always switch down below k_s; lucky OMs and SEs always end up above k_s; accumulating wages is never sufficient to pass the threshold k_s.[24] Under these simplifying assumptions, the transitional dynamics if fully characterized

[24]The saving rate $1-\alpha$ determines the maximal long-run wealth level $\overline{w}$. If k_s is too small, an unsuccessful YSE may still be able to invest k_s if sufficiently rich initially; if k_s is too high, it may not be sufficient to be the offspring of a successful PM or OSE to be able to invest k_s. These alternative assumptions would complicate the transitional dynamics, but would not alter the logic of the trap and the steady-state multiplicity.

by the following equations:

$$\left[\begin{array}{rcl} YW_{\tau+1} & = & (1-p_2)OM_\tau + (1-q)OSE_\tau + OW_\tau, \\ OM_{\tau+1} & = & \theta YW_\tau, \\ OW_{\tau+1} & = & (1-q)YSE_\tau + (1-\theta)YW_\tau, \\ YSE_{\tau+1} & = & p_2 OM_\tau + qOSE_\tau, \\ OSE_{\tau+1} & = & qYSE_\tau \end{array}\right. .$$

In words: YWs at time $\tau + 1$ are the offspring of unsuccessful PWs and OSEs and of OWs: a fraction θ of YWs becomes PWs next period. OWs are the unsuccessful YSEs and unpromoted YWs of the previous period; YSEs are the offspring of successful OSEs and PWs; only successful YSEs are OSEs in their second lifetime period. This Markovian dynamic system admist a unique steady-state social structure determined by:

$$\left[\begin{array}{rcl} YW_\infty & = & \frac{1}{\left(1+\frac{p_2 q}{1-q^2}\right)}, \\ PW_\infty & = & \frac{\theta}{\left(1+\frac{p_2\theta}{1-q^2}\right)}, \\ OW_\infty & = & \frac{\left(1-\theta+\frac{p_2\theta}{1+q}\right)}{\left(1+\frac{p_2\theta}{1-q^2}\right)}, \\ YSE_\infty & = & \frac{\frac{p_2\theta}{1-q^2}}{\left(1+\frac{p_2\theta}{1-q^2}\right)}, \\ OSE_\infty & = & \frac{\frac{qp_2\theta}{1-q^2}}{\left(1+\frac{p_2\theta}{1-q^2}\right)} \end{array}\right. .$$

The corresponding steady-state wage rate $\underline{\nu}_\infty$ is given by:

$$\mu(\underline{\nu}_\infty) = \frac{2-\theta}{0} + \frac{p_2}{1+q}.$$

The existence of a low-mobility steady-state is then equivalent to inequalities (1) and (2) being satisfied for $\nu = \underline{\nu}_\infty$ Inequality (1) is always

satisfied provided that Q is large enough. Moreover, note that $\underline{\nu}_\infty < \overline{\nu}_\infty$, where $\overline{\nu}_\infty = \mu^{-1}\left(\frac{2-\theta}{\theta}\right)$ is the equilibrium wage corresponding to the high-mobility equilibrium derived in Section 2: in words, more promotions imply a higher wage rate in equilibrium. Here lies the key to the history-dependence mechanism: little information accumulated in the past implies that only agents who have no other option enter the corporate sector, so that little information is produced, and the wage rate remains low. Finally, if the ex-ante probability of being of a high-ability type θ is sufficiently small. $\nu \longrightarrow \nu + \theta(y_F(\nu) - k_F - Q|(1-\theta)\nu\ (1-q)\nu$ is an increasing function of ν. It follows that if θ is small enough there exists a non-empty act of SE returns $qy_s - k_s$ such that:

A6:

$$\underline{\nu}_\infty + \theta(y_F(\underline{\nu}_\infty) - k_F - Q) + (1-\theta)\underline{\nu}_\infty \quad < \quad qy_s - k_s + q(qy_s - k_s) + (1-q)\underline{\nu}_\infty,$$
$$\overline{\nu}_\infty + \theta(y_F(\nu_\infty) - k_F - Q) + (1-\theta)\overline{\nu}_\infty \quad > \quad qy_s - k_s + q(qy_s - k_s) + (1-q)\overline{\nu}_\infty.$$

Proposition 6. *If the SE technology satisfies A6, there exists one high-output, high-mobility steady state and one low-output, low- mobility steady state. If θ is small enough there always exist such technologies.*

Thus if the technology is sufficiently skill-intensive (θ small enough), the long-run steady state of the economy depends on its initial stock of information OM_0 as well as on its initial wealth distribution $F_0(w)$. Even in this case, however, acting on $F_0(w)$ alone (through wealth redistribution policies) may not be sufficient to ensure the transition from the trap to "corporate society"; one can even prove that there exist parameter values such that the initial information alone determines the long-run steady state.

4.2.2 A low-mobility trap where the poor are forced into self- employment

Here, we consider the polar case where $k_s = 0$, but where entering the corporate sector as a manual worker requires a minimum level of prior education and training; the sunk cost of education is denoted by $k_w > 0$. Consider the

following inequality:

$$qy_s + (1-y)(qy_s) + q\nu > \nu + \theta(y_F(\nu) - k_F - Q) + (1-\theta)\nu - k_w - Q. \quad (4)$$

This inequality says that the NPV of becoming SE (when future prospects are to remain SE with probability $1-q$ or to become manual worker with probability q) is higher than the NPV for a poor worker to enter the corporate sector. If this inequality is satisfied at wage ν, then agents with current wealth below k_w will systematically enter the informal sector, whereas we assume that agents with current wealth above k_w (who therefore do not have to pay the credit fee Q) always prefer to enter the corporate sector. Furthermore. as in the above subsection, one can always assume that the consumption rate α is high enough and the educational cost k_w is appropriately bounded below and above so that (in the long-run): unlucky OMs and SEs always end up below k_w; lucky OMs and SEs always end up above k_w. Then, if we also assume that a worker can always transmit his educational investment to his offspring,[25] the transitional dynamics of this economy is fully characterized by the following equations:

$$\begin{cases} YW_{t+1} &= p_2 \cdot OM_t + q \cdot OSE_t + OW_t, \\ OM_{t+1} &= \theta \cdot YW_t, \\ OW_{t+1} &= (1-\theta)YW_t + q \cdot YSE_t, \\ YSE_{t+1} &= (1-p_2)OM_t + (1-q)OSE_t, \\ OSE_{t+1} &= (1-q)YSE_t \end{cases}.$$

Note that this Markovian system is identical to that in (a) above, except that the transition probabilities p_2 and q must be systematically replaced by the complementary probabilities $(1-p_2)$ and $(1-q)$. The corresponding steady-state wage rate $\underline{\nu}_\infty$ is thus necessarily given by: $\mu(\underline{\nu}_\infty) = \frac{2-\theta}{\theta} + \frac{1-p_2}{2-q}$.[26]

[25] This last assumption is strong, although its removal would only reinforce the existence of a low-mobility trap with an even more overwhelming SE sector! (See footnote 23.)

[26] If a fraction ϵ of old workers' offspring fell below k_w, one can prove that $\underline{\nu}_\infty$ would be given by:

$$\mu(\underline{\nu}_\infty) = \frac{1}{\theta} + \frac{\left(\frac{1-\theta}{\theta} + \frac{1-p_2}{2-q}\right)}{\left[1 - \frac{\epsilon}{2-q}\right]} > \frac{2-\theta}{\theta} + \frac{1-p_2}{2-q} > \frac{2-\theta}{\theta}.$$

Again, we have $\underline{\nu}_\infty < \overline{\mu}_\infty = \mu^{-1}\left(\frac{2-\theta}{\theta}\right)$, where $\overline{\nu}_\infty$ is the equilibrium wage corresponding to the high-mobility equilibrium of Section 2. Moreover, if the ex-ante probability of being of a high-ability type is sufficiently small, $\nu \longrightarrow \nu + \theta(y_F(\nu) - k_F - Q) + (1-\theta)\nu - q\nu$ is an increasing function of ν. It follows that if θ is small enough there exists a non-emptv set of parameters (y_s, k_{wZ}, Q) such that the above inequality (3) is satisfied for $\nu = \underline{\nu}_\infty$ but not for $\nu = \overline{\nu}_\infty$.

Proposition 7. *If the technology is sufficiently skill- intensive (θ small enough), there exist two steady states for an open set of SE productivities.*

This latter type of low- development trap where the uneducated poor populate an overwhelming informal sector appears to be particularly widespread in Latin America. A noticeable exception seems to be Colombia, however, where a work-life in the informal sector appears to be more profitable than an average working career in the formal sector, an instance of the former type (a) of low- development trap (see Hinestrosa (1990)).

5 Concluding Comments

In the theory developed in this paper, the allocation of agents to tasks operates through the internal detection of natural talents within organizations and we analyzed the positive and efficiency properties of this mechanism. In developed countries, however, investments in formal education have ceased for some time to be of negligible quantitative importance: typically educational signals are publicly observable and they may well have replaced (at least partly) internal detection and promotion as the main informational channel of allocation of agents to tasks. However the extent to which formal education signals (as opposed to internal detection, training and promotion) have become preponderant is widely debated (see Bell (1974) and Erikson and Goldthorpe (1992) for two conflicting views).

In order to address these issues one may want to model the dynamic interactions between educational systems, corporations and markets in terms of the

Thus, as argued in the previous footnote, this would only reinforce the trap.

resulting social-mobility patterns. For example, if technological development is characterized by an increasing y_F and a decreasing θ, then these interactions may endogeneously generate a $\cap$-shaped curve between development and the rates of social ascent: the latter would first increase with the rise of large corporations, but may start decreasing as private educational investments (typically correlated with social origins) take over natural talents to become the preponderant criterion for occupational choice and promotion.[27] Such an evolution is consistent with the common place, according to which successful careers used to be more open to talented individuals with no strong educational background a few decades ago than today.[28]

[27] Assume that the education technology converts an individual into a high-ability type for sure provided a fixed investment E is sunk; then private education investments take over naturally at the development stage where y_F is sufficiently high that investing in ability acquisition covers the fixed educational cost E.

[28] Note that this contradicts strongly the dubious "liberal theory of industrialization" (see Erikson and Goldthorpe (1992, chapter 1)), according to which market-driven development per se implies continuous increases on social mobility rates.

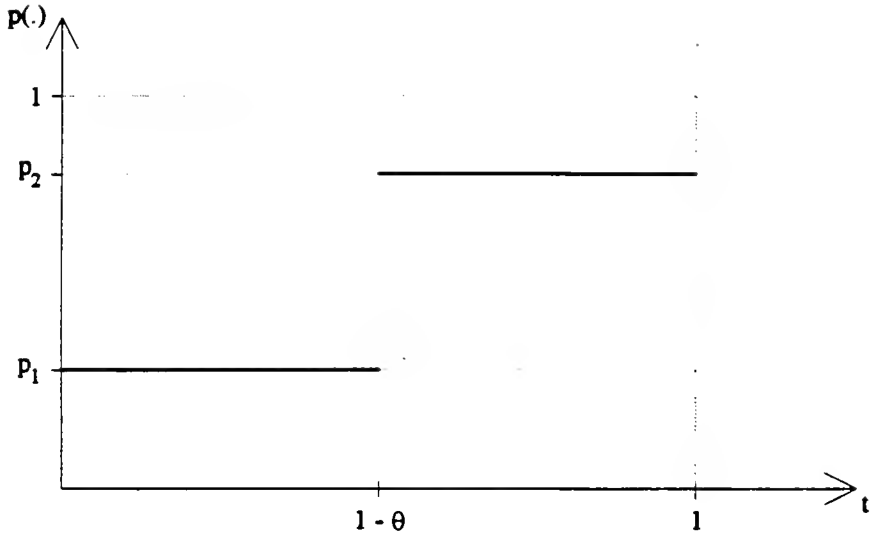
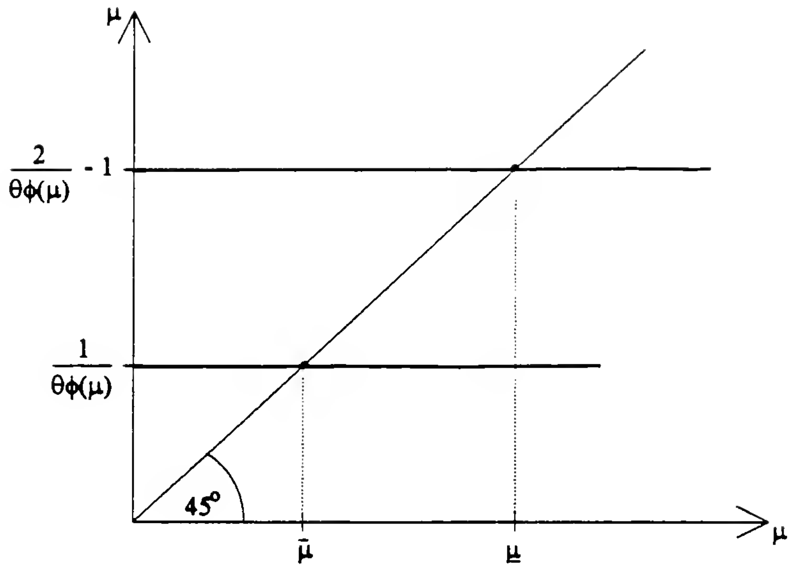
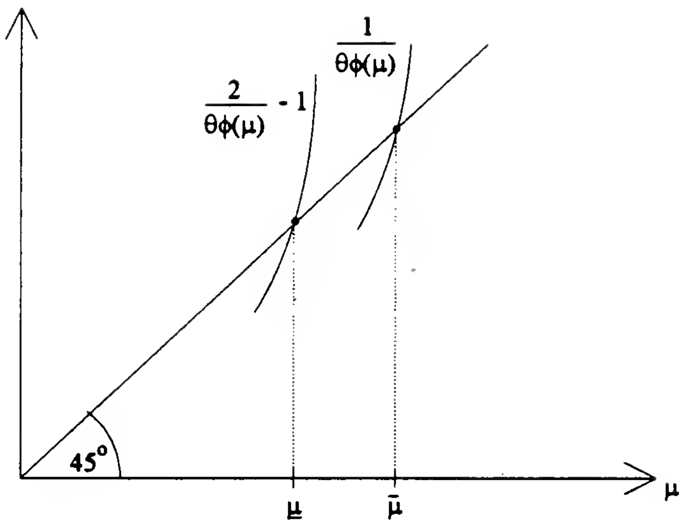


Figure 1



μ
$\frac{2}{\theta\phi(\mu)} - 1$
$\frac{1}{\theta\phi(\mu)}$
45°
$\bar{\mu}$
$\underline{\mu}$
μ

Figure 2



$\frac{1}{\theta\phi(\mu)}$
$\frac{2}{\theta\phi(\mu)} - 1$
45^{o}
μ
$\underline{\mu}$
$\bar{\mu}$

Figure 3

References

[1] Aghion P. and P. Bolton (1991), "A Trickle-Down Theory of Growth and Development with Debt Overhang," mimeo, Oxford and London School of Economics.

[2] Andreoni (1989), "Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence," *Journal of Political Economy* 97, 1447-58.

[3] Hinestrosa, P. (1990), *Three Essays on Informal Markets in Colombia*, unpublished Ph.D. dissertation, Columbia University.

[4] Banerjee, A. and Newman (1993), "Occupational Choice and the Process of Development," *Journal of Political Economy*.

[5] Bénabou, R. (1992), "Heterogeneity, Stratification and Growth," mimeo, MIT.

[6] Bernhardt (1993), "Strategic Promotion and Compensation," mimeo, Queen's University.

[7] Calvo and Wellisz (1979), "Hierarchies, Ability and the Distribution of Income," *Bell Journal of Economics*.

[8] Erikson and Goldthorpe (1992), *The Constant Flux: A Study of Class Mobility in Industrial Societies,* Oxford: Clarendon Press.

[9] Galor, O. and J. Zeira (1993), "Income Distribution and Macroeconomics," *Review of Economic Studies*.

[10] Goldthorpe (1992), "Problems of 'Meritocraty'," mimeo, Oxford.

[11] Hart, O. and J. Moore (1991), "A Theory of Debt Based on the Inalienability of Human Capital," mimeo, MIT and LSE.

[12] Kaelble, H. (1985), *Social Mobility in the 19^{th} and 20^{th} Century: Europe and America in Comparative Perspective*, New York: St. Martin's Press.

[13] Kremer, M. (1993), "The O-ring Theory of Economic Development," *Quarterly Journal of Economics.*

[14] Legros, P. and Newman (1993), "Wealth Effects, Distribution and the Theory of Organizations," mimeo, Northwestern University.

[15] Lucas, R.E. (1993), "Making a Miracle," *Econometrica.*

[16] Meyer (1991), "Learning from Coarse Information: Biased Contests and Career Profiles," *Review of Economic Studies.*

[17] Piketty, T. (1992), "Imperfect Capital Markets and Persistence of Initial Wealth Inequalities," Discussion Paper LSE/STICERD n TE/92/255.

[18] Prendergast, C. (1991), "Career Development and Specific Human Capital Collection," Working Paper, Graduate School of Business, University of Chicago.

[19] Waldman (1984), "Job Assignments, Signalling and Efficiency," *Rand Journal of Economics 2*, 255-67.

[20] Young, Alwyn (1991), "Learning by Doing and the Dynamic Effects of International Trade," *Quarterly Journal of Economics.*

3248 024

Date Due

' 3 1 2005		
		Lib-26-67